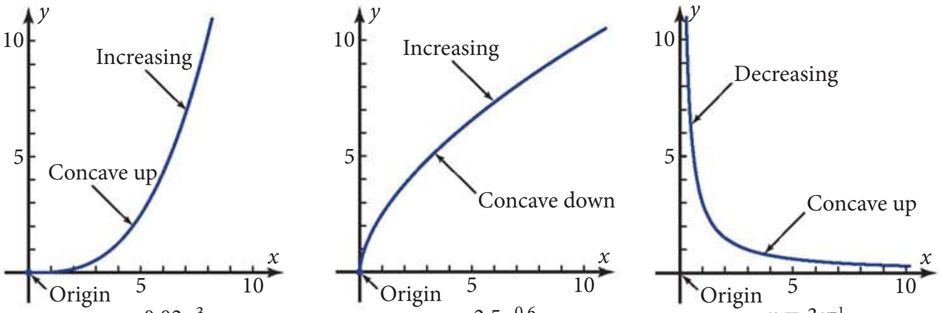
Graphical properties: Figure 2-2c shows power function graphs for different values of b. In all three cases, $a > 0$. The shape and concavity of the graph depend on the value of b. The graph contains the origin if $b > 0$; it has the axes as asymptotes if $b < 0$. The function is increasing if $b > 0$; it is decreasing if $b < 0$. The graph is concave up if $b > 1$ or if $b < 0$ and concave down if $0 < b < 1$. The concavity of the graph describes the *rate* at which y increases. For $b > 0$, concave up means y is increasing at an *increasing rate,* and concave down means y is increasing at a *decreasing rate.*



$y = 0.02x^3$
Exponent greater than 1

$y = 2.5x^{0.6}$
Exponent between 0 and 1

$y = 3x^{-1}$
Exponent negative

Figure 2-2c: Power functions

Exponential Functions

Marie Curie was awarded the Nobel Prize in chemistry for the discovery of radioactive elements (polonium and radium) in 1911. The breakdown of radioactive elements follows an exponential function.

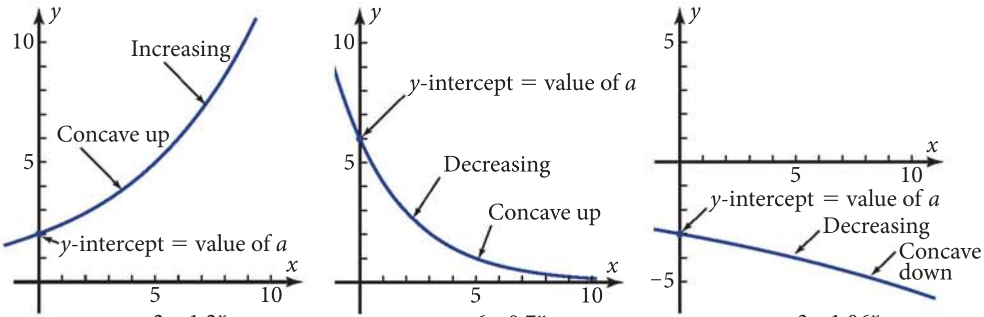
General equation: $y = ab^x$, where a and b are constants, $a \neq 0$, $b > 0$, $b \neq 1$, and the domain is all real numbers

Parent function: $y = b^x$, where the asymptote is the x-axis

Verbally: In the equation $y = ab^x$, "y varies exponentially with x."

Translated function: $y = ab^x + c$, where the asymptote is the line $y = c$. Unless otherwise stated, "exponential function" will imply the untranslated form, $y = ab^x$.

Graphical properties: Figure 2-2d shows exponential functions for different values of a and b. The constant a is the y-intercept. The function is increasing if $b > 1$ and decreasing if $0 < b < 1$ (provided $a > 0$). If $a < 0$, the opposite is true. The graph is concave up if $a > 0$ and concave down if $a < 0$.



$y = 2 \cdot 1.2^x$
Base greater than 1

$y = 6 \cdot 0.7^x$
Base between 0 and 1

$y = -3 \cdot 1.06^x$
Coefficient negative

Figure 2-2d: Exponential functions